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NOTES ON THE FLORA OF LESLIE GULCH, MALHEUR COUNTY, OREGON

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ABSTRACT

Several endemics occur on certain substrates in the Owyhee Region of Malheur County, Oregon where normal vegetation is excluded. It has been hypothesized that chemical features of the substrates account for the endemism and exclusion of normal vegetation. Chemical and mineralogical test results presented here lead to the conclusion that physical rather than chemical characteristics account for plant distribution.

Leslie Gulch is a drainage of about 90 km^2 that empties into Owyhee Reservoir, Malheur County, Oregon. The gulch lies on the west side of the Sucker Creek Formation of the Owyhee Region of Kittleman et al. (1965). The original spelling Succor Creek was changed to Sucker Creek in the first revision of the Mitchell Butte Quadrangle in 1921 (Axelrod 1964). Kittleman et al. (1965) named the Sucker Creek Formation from the spelling on this map. Currently the Board of Geographic Names lists the correct spelling as Succor Creek. However, the name of a stratigraphic formation cannot be changed. The entire region has a complicated stratigraphy of volcanic rocks and volcanic sediments. Leslie Gulch itself cuts through a very isolated geologic deposit and is the center of an area with a large number of rare and interesting plant species. The ash-tuff typical of the gulch is composed of sparse phenoclasts of quartz and sanidine in a vitroclastic matrix and has been named the Leslie Gulch Ash-Flow Tuff Member of the Sucker Creek Formation (Kittleman et al. 1965).

Within Leslie Gulch eight rare plant species are known to occur. Three of them, *Astragalus sterilis* Barneby, *Eriogonum novonudum* Peck, and *Trifolium owyheense* Gilkey, are endemic to the Owyhee Region, where they grow almost exclusively on outcrops of volcanic material. *Ivesia rhypara* Ertter & Reveal is known from two locations in Leslie Gulch and one in Nevada. *Artemisia packardiae* Grimes & Ertter grows on dikes of Jump Creek Rhyolite in Leslie Gulch and on cliff faces of similar rhyolites along the Owyhee River to the south. *Senecio ertterae* Barkley, *Mentzelia packardiae* Glad, and *Phacelia lutea* var. *mackenziorum* Grimes & Packard grow only on

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talus slopes of a greenish-yellow ash-tuff in lower Leslie Gulch and Spring Creek Gulch immediately adjacent southward. These slopes are quite distinct from the Leslie Gulch Ash-Flow Tuff Member exposed in upper Leslie Gulch. Kittleman et al. (1965) made no mention of the greenish-yellow ash-tuff in their description of the Leslie Gulch Ash-Flow Tuff Member. I refer to it as talus-tuff because it tends to form extensive talus slopes.

It is well known that features of edaphic habitats may inhibit plant growth yet support rare or endemic plant species. Glad (1976) stated that both *Mentzelia packardiae* and *M. mollis* Peck grow on green or grey montmorillonite derived from the Sucker Creek Formation. Her tests showed extremely high concentrations of potassium, and she therefore concluded that the potassium content of the 'soil' excluded normal vegetation and accounted for the apparent edaphic endemism of the mentzelias. Tests were performed to evaluate the hypothesis that the chemical features of the Leslie Gulch Ash-Flow Tuff restricted plant distribution.

Methods

Three study sites were chosen on the basis of elevational differences and the presence of large populations of endemic species. The first site is at the head of Leslie Gulch and supports the largest known population of *Ivesia rhypara.* The other two sites support large populations of *Senecio ertterae, Mentzelia packardiae,* and *Phacelia lutea* var. *mackenziorum,* the first near Mud Spring (1200 m) and another 0.9 km above Owyhee Reservoir (900 m).

Emission spectrography tests on the substrates were performed at the Utah Engineering Experiment Station at the University of Utah to determine if any unusual ions were present, or if any ions were present in unusual amounts. Samples of some of the endemic plants were also tested to see if they were accumulating any of these ions.

Cation exchange capacity (CEC) determinations were done at the Soil, Plant and Water Analysis Laboratory at Utah State University to determine the quantity of exchangeable ions in the substrates. Percent nitrogen was also checked as an indication of the amount of organic matter. The CEC of some soil at the bottom of the Mud Spring talus slope was also determined, after a zeolite was discovered, to see if the zeolite was accumulating in normal soil.

Gravimetric water content was tested to get a relative idea of the amount of water available to the plants. Samples were screened to get particle size distribution, and individual fragments were examined microscopically. Anatomical sections were made of the roots of *Mentzelia packardiae,* which at times have noticeably mucilaginous sheaths, to check for anatomical adaptations.

Results and Discussion

The results of the chemical and mineralogical tests gave no indication of any chemical feature that would limit or restrict plant growth in either the talus-tuff or the Leslie Gulch Ash-Flow Tuff. It is more likely that the distribution of the endemics in Leslie Gulch is determined by physical rather than chemical factors.

The results of the emission spectrography tests showed that there are no elements present in unusual amounts, and that no unusual ions are present. Likewise, ions are not accumulating in any of the plants. Tests performed by Richard Halse in his study of *Phacelia* sect. *Miltitzia* (Halse, unpubl. data) also did not show unusual amounts of potassium. The results of the X-ray diffraction showed that at least one zeolite, heulandite, is present in the talus-tuff. The talus-tuff had a very high CEC, 60–100 meq/100 g, while that of the Ash-Flow Tuff was very low, 3–6 meq/100 g. The CEC of the soil below the talus slope showed no evidence that the zeolite was being accumulated in the soil. The presence of the zeolite is in some respects unusual. However, if other edaphic factors, such as the amount of organic matter and the physical characteristics of the substrate, were more suitable, the zeolite might have a beneficial rather than a limiting effect on plant growth. Alternatively, the heulandite might play a role in restricting plant growth if the ions available are not present in proportions that are suitable for plants.

None of the samples tested had greater than 0.03% N.

Gravimetric determinations showed that water accounted for 13–19% of the weight of the talus-tuff during the growing season. Water content of the Ash-Flow Tuff was almost negligible. Although measurements of gravimetric water content in the talus-tuff indicate that the absolute amount of water is probably not a limiting factor, they give no indication of how the water is distributed within the talus-tuff, nor how much of it is available to the plants.

Most of the talus-tuff will not pass through a #10 screen, indicating a very porous environment for the roots. Microscopic examination of individual fragments of talus-tuff showed them to be very porous; much of the water in the samples had apparently soaked into these fragments. When roots of the *Mentzelia, Senecio,* or *Phacelia* come into contact with pieces of talus or bedrock the roots branch into innumerable rootlets that cling to or penetrate large pores in the talus fragments. The water supply within the fragments might be much higher in volume than the water vapor present in the pores among the fragments. The distribution of water in such talus slopes is very different from that of water in substrates with smaller pores, such as loam.

The frequent shifting of the talus slopes also has an impact, both directly and indirectly on the establishment of plants. First of all, the frequent movement of the substrate almost entirely precludes the establishment of an organic layer and hence of distinct soil horizons. Second, the shifting talus presents problems for seed germination and seedling survival. Early spring, when water relations are most favorable for germination and establishment of propagules, is the season when increased moisture content makes the slopes least stable. It is interesting to note that the *Mentzelia, Senecio,* and *Phacelia* all germinate in later spring to early summer. *Senecio ertterae, Mentzelia packardiae,* and *Phacelia lutea* var. *mackenziorum* show several adaptations to these talus slopes. The roots of all three are quite fleshy, and at least those of the *Mentzelia* are at times mucilaginous. Cross sections of roots of *M. packardiae* showed no anatomical adaptations, but the mucilaginous sheath was evident. Fleshy organ development is a typical response to arid habitats, and the mucilaginous sheath may be an adaptation to help protect the roots from desiccation.

The root systems of the annuals are also quite extensive, the lateral growth much exceeding the vertical. The plants often grow in dense stands, and hundreds of intertwining root systems materially stabilize the talus.

The outcrops of the Leslie Gulch Ash-Flow Tuff also offer a harsh physical environment to which several plants have adapted. The results of the CEC and percent-N tests show that these outcrops are edaphically even more sterile than the talus-tuff. Although the absolute amounts of essential elements are about the same, the Ash-Flow Tuff does not have a zeolite with a correspondingly high CEC. On these exposed outcrops wind and water prevent the accumulation of organic matter, nitrogen build-up, and soil formation. The rubble layer that does develop is very shallow (seldom more than 4 or 5 cm). *Ivesia rhypara, Astragalus sterilis, Eriogonum novonudum,* and *Trifolium owyheense* all show adaptations of their root systems that maximize the use of available resources. *Ivesia rhypara* has very long extensively branching roots that creep over the surface of the bedrock under any rubble that may accumulate. In Leslie Gulch plants are generally found along cracks into which the tough woody roots apparently penetrate quite deeply. At the Nevada locality the substrate appears to be a combination of alluvium with much unsorted material, as well as ash or tuff deposits similar to those found in Leslie Gulch, but nothing is known about its chemistry (for a discussion of this species, see Ertter 1983). *Astragalus sterilis* and *Trifolium owyheense* have large fleshy or woody roots that also penetrate deeply into cracks. At the bedrock-rubble interface several stems issue from the roots and grow through the rubble layer. *Eriogonum novonudum* also sends large woody roots into cracks in the bedrock, but its caudex is lifted above the rubble layer. Deep roots from which stems emerge through a rubble layer are a common feature of plants of talus and bedrock outcrops throughout the area (pers. obs.), including *Trifolium leibergii* Nels. & Macbr. and *Arenaria nuttallii* var. *fragilis* Mag. & Holmgren.

Artemisia packardiae Grimes & Ertter is another Owyhee Region endemic that has a unique edaphic relationship and distribution. This species was not found until field work had been completed. Consequently no chemical or mineralogical tests were performed on its substrate. Since its initial discovery at Three Forks of the Owyhee River and in Leslie Gulch, it has been found to grow extensively on rhyolitic cliffs near Three Forks, and along the Owyhee River between Rome and Owyhee Reservoir. There is another population on cliff faces in Succor Creek State Park some 16 km northeast of Leslie Gulch. These rhyolitic cliffs are apparently remnants of more extensive rhyolitic formations that covered much of the Owyhee Region during the moister parts of the Miocene and Pliocene. Again, physical features of the habitat probably account for the distribution of *A. packardiae* today. Grimes and Ertter (1979) suggested that *A. packardiae* is a relict species that evolved from populations of *A. michauxiana* Bess. subsequent to the Pleistocene glaciations. It is likely that immediately after the glaciations, while *A. packardiae* is hypothesized to have been evolving, the area was moister than today. Danin and co-workers (Danin 1972, Danin et al. 1975) have found that plants growing on cliff faces may receive more moisture than those growing on adjacent flats and slopes. Raven and Axelrod (1978) suggest that plants confined to limestone cliffs in California may also be relicts of a Pleistocene flora. *A. packardiae* then might also be restricted by physical features of a diminishing habitat.

Conclusions

The rare and endemic species of the Owyhee Region are probably not so much adapted to chemical features of the substrates as to the harsh physical features of the outcrops, talus slopes, and cliff faces on which they grow. The species all show morphological adaptations to their environment. It is likely that these species are pioneers adapted to recently exposed habitats and that they might be competitively excluded from more normal substrates (i.e., soil). Other workers (Gankin and Major 1964, Kruckeberg 1954) have demonstrated that endemics may be restricted to edaphic sites by low competitive ability. Observations on the Owyhee Region endemics growing on ecotonal areas support this idea. All of the species will grow on ecotonal areas where edaphic conditions are less harsh. However, as density of other species increases the density of the endemics decreases. Glad (pers. comm.) tried without success to germinate seeds of *Mentzelia mollis* and *M. packardiae* to test this hypothesis.

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PUBLICATION ANNOUNCEMENT

The Kingston Range of California: A Resource Survey. Natural and Cultural Values of Kingston Range, Eastern Mojave Desert, California. Rising over 7000 feet from the desert floor of the Mojave, the Kingston Range harbors on its slopes and peaks a remarkable array of plants, animals, geological formations, and archaeological sites. Little was known of the area's natural and cultural resources until a team of nine UC Santa Cruz undergraduates set out to compile a record of what Environmental Field Program director Dr. Ken Norris calls these ". . . high islands, surrounded by a sea of inhospitable desert."

The Kingston Range of California: A Resource Survey documents the results of the team's study. This 393-page book contains separate chapters describing the area's geology, vegetation and flora, vertebrate fauna, archaeology, and history, as well as a section on land-use policy and analysis. The comprehensive descriptions should provide a valuable reference for land-use planners, policy makers, or anyone interested in the unique mountain ranges of the Mojave.

The Kingston Range of California: A Resource Survey is bound in paper and illustrated with black-and-white photographs, drawings, and maps. Copies are available for $14.00 each (Please make checks payable to the UC Regents), plus $2.00 for postage and handling, from: Environmental Field Program, 231 Kerr Hall, University of California, Santa Cruz, CA 95064.

NEW AND RECONSIDERED MEXICAN ACANTHACEAE

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ABSTRACT

Pseuderanthemum pihuamoense, distinguished by a broad, nontapering wing on the petioles and relatively long bracts, and **Henrya tuberculosperma**, distinguished by a relatively long, pubescent capsule and large, tuberculate seeds, are described from west-central Mexico. The new combination **Holographis peloria** is made based on *Stenandrium pelorium* Leonard, and a new name, **Louteridium rzedowskii**, is proposed for *L. brevicalyx* Rzedowski. Keys are provided to contrast each taxon with its relatives.

Studies of Acanthaceae from west-central Mexico have resulted in the discovery of several new taxa (Daniel 1980, 1981) and many range extensions of previously described taxa. During the preparation of a treatment of the family for McVaugh's *Flora Novo-Galiciana,* additional new species have been found and several taxonomic alterations and nomenclatural modifications have become necessary. In this report two species are newly described from west-central Mexico, a new combination is made in *Holographis,* and a new name is proposed for *Louteridium brevicalyx* Rzedowski.

Pseuderanthemum pihuamoense T. F. Daniel, sp. nov.

Planta suffruticosa usque ad 6 dm alta. Folia ovata vel elliptica, 50–200 mm longa, 20–70 mm lata, basi late (7–27 mm lata) alata. Bracteae lanceolatae vel subulatae, 3–15 mm longae. Bracteolae subulatae, 1.5–4.0 mm longae. Calyx 4–6 mm longus, glandulosus. Corolla non vidi. Capsula 14–17 mm longa, glandulosa. Semina 3.0–3.5 mm longa. Fig. 1.

Erect subshrubs to 6 dm tall; stems subquadrate, sparsely pubescent with retrorse or antrorse trichomes, 0.2–0.3 mm long, or glabrous above, glabrate below; leaves ovate to elliptic, 50–200 mm long, 20–70 mm wide, mostly 2.5–3.5 times longer than wide, the blades tapering to a broad, nontapering (7–27 mm wide) wing extending to the node, the wing truncate to subcordate at base, the leaf apex acuminate to subfalcate, the surfaces sparsely pubescent; flowers borne in opposite, sessile to subsessile dichasia (these usually reduced to one flower) from upper leaf axils or in an inflorescence of axillary or terminal spikes, the spike axis densely pubescent with stiff, flexuose to antrorse, mostly eglandular trichomes; bracts lan-

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FIG. 1. Holotype of *Pseuderanthemum pihuamoense* T. F. Daniel.
FIG. 2. Holotype of *Henrya tuberculosperma* T. F. Daniel.

ceolate to subulate, 3–15 mm long, 0.5–3.0 mm wide, pubescent like the inflorescence axes; bractlets subulate, 1.5–4.0 mm long, 0.3–0.7 mm wide, pubescent like the inflorescence axes; calyx 5-lobed, 4–6 mm long, glandular (the glands often inconspicuous), the lobes subulate, 3.5–4.5 mm long; corolla not seen; capsule 14–17 mm long, sparsely glandular on outer surface; seeds plano-convex, 3.0–3.5 mm long, 3 mm wide, covered with irregular ridges largely composed of tubercules bearing minute barbs.

TYPE: Mexico, Jalisco, ca. 12–13 km sw. of Pihuamo [ca. 19°15′N, 103°25′W], 19 Nov 1970, *McVaugh 24459* (Holotype: MICH!).

PARATYPE: Mexico, Jalisco, 12.8 km sw. of Pihuamo, 6 Dec 1959, *McVaugh & Koelz 1500* (MICH).

Habitat. Steep rocky (limestone) hillsides in dense forest dominated by *Brosimum* at an elevation of about 550 m.

Although the two collections of this species cited above lack corollas, this species appears to belong to *Pseuderanthemum.* It closely resembles other species of this genus in features of the capsule and seed. *Pseuderanthemum pihuamoense* is distinctive among Mexican and Central American species of the genus by the broad, nontapering petiolar wing that is subcordate to truncate at its base. This species can be distinguished from other species occurring in western Mexico by the following key:

1. Leaf blades forming a conspicuous wing along the petiole, the wing 7–27 mm wide (from edge to edge), not tapering towards the node, truncate to subcordate at base; bracts 3–15 mm long. .... *P. pihuamoense*
1. Leaf blades merely decurrent along the petiole (sometimes scarcely so), a wing, if present, 1–6 mm wide, tapering towards the node, long-attenuate to acute at base; bracts 0.7–4.0 mm long.
   2. Calyx 5.5–8.5 (–12.0) mm long; thecae 2.5–3.0 mm long; leaves often absent at anthesis, the petioles to 5 mm long, the blade only slightly decurrent along the petiole, if at all. .... *P. praecox*
   2. Calyx 2.0–4.5 mm long; thecae 1.0–2.2 mm long; leaves present at anthesis, the petioles 5–150 mm long, the blade decurrent almost to the node.
      3. Corolla 10–14 mm long; bracts 1.8–3.0 mm long; bractlets subulate, 1.0–2.5 mm long; calyx 3.5–4.5 mm long; seeds 2.5–3.5 mm long. .... *P. standleyi*
      3. Corolla 27–36 mm long; bracts 0.7–1.5 mm long; bractlets triangular, 0.5–0.8 mm long, calyx 2–3 mm long; seeds 2.0–2.5 mm long. .... *P. alatum*

Henrya tuberculosperma T. F. Daniel, sp. nov.

Frutex usque ad 1 m altus. Caules subquadrati glandulosi. Folia petiolata, laminae ovatae, 25–80 mm longae, 10–55 mm latae. Inflorescentia spicata densa. Bracteae lanceolatae vel oblanceolatae, 5–7 mm longae, glandulosae. Bracteolae oblanceolatae, 9–14 mm longae, glandulosae. Corolla luteola vel albida, 14–19 mm longa. Capsula 8–11 mm longa, pubescens. Semina 2.5–3.5 mm longa, glabra, tuberculata. Fig. 2.

Shrubs to 1 m tall; stems subquadrate, evenly pubescent with a mixture of eglandular and glandular trichomes 0.1–0.5 mm long near apex, sparsely pubescent (often in opposite, vertical lines) to glabrate below; leaves petiolate, the petioles to 20 mm long, the blades ovate, 25–80 mm long, 10–55 mm wide, rounded to acute to truncate at base, acute to acuminate at apex, the surfaces sparsely pubescent; flowers borne in dense, axillary or terminal, erect or ascending spikes to 10 cm long, the spike axis glandular; bracts lanceolate to oblanceolate, 5–7 mm long, 1–2 mm wide, glandular; bractlets oblanceolate, 9–14 mm long, glandular, mucronate at apex, the mucro 0.2–0.8 mm long; calyx 2.5–3.0 mm long, the lobes lance-subulate, glandular, subequal, the four primary lobes 2.0–2.5 mm long, the reduced lobe 0.5–1.0 mm long; corolla pale yellow or